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EXAMINER	
HAN, JONATHAN	

ART UNIT	PAPER NUMBER
2818	

NOTIFICATION DATE	DELIVERY MODE
09/30/2011	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	**Application No.** 10/585,638	**Applicant(s)** OHNO ET AL.	
	Examiner JONATHAN HAN	**Art Unit** 2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 June 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-21* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-21* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *25 May 2010* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1-2, 5, 7-10, 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in view of Nickel et al. (U.S. Patent No. 5,835,003).

With respect to claim 1, Sakakima discloses in Figure 7A-7B a current injection-type magnetic domain wall-motion device comprising a first magnetic body [1'] (nearest to top), a second magnetic body [1'] (nearest to the bottom) with a magnetization direction antiparallel to that of the first magnetic body, a third magnetic body [3], a first microjunction interface between the first and third magnetic bodies and a second

microjunction interface between the third and second magnetic bodies (See Figure 7a-7b) wherein the magnetization direction of the third magnetic body is controlled in such a manner that a current is applied to pass through the first and second microjunction interfaces such that a magnetic domain wall present between the first and second magnetic bodies is moved within the third magnetic body in the same direction as that of the current or in the direction opposite to that of the current by the interaction between the magnetic domain wall and the current (see Column 15, lines 55-60).

Sakakima fails to disclose wherein the first magnetic body is directly adjacent to a third magnetic body and a second magnetic body directly adjacent to the third magnetic body and wherein the magnetization direction of the third magnetic body is controlled via direct flow of the current.

Nickel discloses a first magnetic body [206] is directly adjacent to a third magnetic body [204] and a second magnetic body [202] directly adjacent to the third magnetic body and wherein the magnetization direction of the third magnetic body is controlled via direct flow of the current (see Column 4 lines 49-59).

It would have been obvious to one of ordinary skill in the art at the time of invention to implement the magnetoresistance orientation of Nickel in order to allow for greater current flow through the third magnetic layer thereby allowing for large exchange fields and greater efficiency of the device (see Nickel, Column 4, lines 60-65)

With respect to claim 2, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the magnetic bodies are made of a magnetic semiconductor (see Sakakima Column 15, lines 27-37, Column 16,

lines 27-37).

With respect to claim 5, the combination of Sakakima and Nickel disclose all material as stated in claims 1-2, and further discloses wherein the current is a pulse current (see Sakakima Column 24, lines 62-66).

With respect to claim 7, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the first [1'] (nearest to top of device) and second magnetic [1'] (lowest 1' of the device) bodies (see Figure 7B) are prepared by film formation (see Sakakima Column 12, lines 13-20; initial structure is formed based on films) in a magnetic field (see Sakakima Column 15, lines 55-60).

With respect to claim 8, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the magnetization directions of the first [1'] (nearest to top of device) and second magnetic bodies [1'] (nearest to the bottom of device) are aligned antiparallel to each other (see Sakakima Figure 7B) with an external magnetic field using a difference in coercive force therebetween after a film formation (see Sakakima Column 18, lines 5-17; different thicknesses allow for difference coercive forces).

With respect to claim 9, the combination of Sakakima and Nickel discloses all material as stated in claim 8, and further discloses wherein the first and second magnetic bodies are made of different materials (see Sakakima Column 18, lines 11-17; any of the disclosed materials can be used).

With respect to claim 10, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the first and second

magnetic bodies are made of the same material and the second magnetic body is magnetically coupled with an antiferromagnetic film disposed on the second magnetic body such that the first and second magnetic bodies have different coercive forces (see Sakakima Column 13, lines 36-44).

With respect to claim 18, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the magnetization direction of the third magnetic body can be read out (see Sakakima Column 24, lines 62-66).

With respect to claim 19, the combination of Sakakima and Nickel discloses all material as stated in claim 18, and further discloses wherein the magnetization state of the third magnetic body is read out in such a manner that the resistance of the third magnetic body is measured by applying a small current that is insufficient to move the magnetic domain wall (see Sakakima Column 24, lines 62-66; only the magnetization of the soft magnetic film is inverted), to a current injection terminal using a feature that the device has different resistances depending whether the magnetic domain wall is located at the first or second microjunction interface (see Sakakima Column 26, lines 37-59; by changing the position of the domain wall, the resistance values increase or decrease in relation to the hard magnetic film rotation).

With respect to claim 20, the combination of Sakakima and Nickel discloses all material as stated in claim 19, and further discloses wherein the first and second microjunction interfaces are formed to have asymmetric structure such that a difference in resistance is readily created in the third magnetic body (see Sakakima Column 26, lines 37-59 and Column 28, lines 7-14).

With respect to claim 21, the combination of Sakakima and Nickel discloses wherein the first and second magnetic bodies have fixed magnetization directions (See Nickel Figure 3B)

4. Claims 3-5 rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in view of Nickel et al. (U.S. Patent No. 5,835,003) as applied to claim 2 above, and further in view of Chang et al. (U.S. Patent No. 5,294,287; hereinafter referred to as Chang).

With respect to claim 3, the combination of Sakakima and Nickel discloses all material as stated in claim 2, but fails to disclose wherein the magnetic semiconductor is a (Ga, Mn)As ferromagnetic semiconductor.

Chang discloses the magnetic semiconductor is an (Ga, Mn)As ferromagnetic semiconductor (see Column 8, lines 10-18).

It would have been obvious to one of ordinary skill in the art at the time of invention to employ an (Ga, Mn)As ferromagnetic semiconductor in the magnetic structure as taught by Sakakima, in order to produce the three magnetic semiconductor bodies that would result in the desired magnetic ordering and electronic conduction (see Chang Column 6, lines 38-44).

With respect to claim 4, the combination of Sakakima and Nickel discloses all material as stated in claim 2, but fails to disclose wherein the magnetic semiconductor is an (In, Mn)As ferromagnetic semiconductor.

Chang discloses the magnetic semiconductor is an (In, Mn)As ferromagnetic

semiconductor (see Column 8, lines 10-18).

It would have been obvious to one of ordinary skill in the art at the time of invention to employ an (In, Mn)As ferromagnetic semiconductor in the magnetic structure as taught by Sakakima, in order to produce the three magnetic semiconductor bodies that would result in the desired magnetic ordering and electronic conduction (see Chang Column 6, lines 38-44).

With respect to claim 5, the combination of Sakakima, Nickel and Chang disclose all material as stated in claims 3-4, and further discloses wherein the current is a pulse current (see Sakakima; Column 24, lines 62-66).

Claims 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in view of Nickel et al. (U.S. Patent No. 5,835,003) and Chang et al. (U.S. Patent No. 5,294,287; hereinafter referred to as Chang) as applied to claims 3-5 above, and further in view of Grollier et al. ("Switching a spin valve back and forth by current-induced domain wall motion", hereinafter referred to as "Grollier").

With respect to claim 6, the combination of Sakakima, Nickel and Chang disclose all material as stated in claim 5, but fails to disclose wherein the pulse current has a current density of 10^4-10^7 A/cm^2.

Grollier discloses the pulse current has a current density of the order of 10^6A/cm^2 and there is some uncertainty in the exact value of the current density (see Grollier, Page 510, Paragraph 2).

While Grollier does not explicitly disclose the range of the pulse current has a

current density of 10^4-10^7 A/cm^2, it has been held that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to implement the proper current density during the implementation of the device as disclosed by the combination of Sakakima, Nickel and Chang, resulting in a displacement of the domain wall (see Grollier, Page 510, Paragraph 2)

5. Claims 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in view of Nickel et al. (U.S. Patent No. 5,835,003) as applied to claim 1 above, and further in view of Wang et al. (U.S. Patent No. 6,713,195; hereinafter referred to as Wang).

With respect to claim 11, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses wherein the first and second magnetic bodies are made of the same material (see Column 17, lines 62-66 and Column 18, lines 11-17) but fails to explicitly disclose wherein the first and second magnetic bodies have different film thicknesses, such that the first and second magnetic bodies have different coercive forces.

Wang discloses the first and second magnetic bodies are made of the same material, and have different film thicknesses, such that the first and second magnetic bodies have different coercive forces (see Column 5, lines 3-14).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the thickness of the magnetic memory as disclosed by Sakakima to

vary the switching thresholds for each of the outside composite layers while in a magnetic field as taught by Wang to allow for better control of the ferromagnetic layers and current resistivity in response to an externally applied operating magnetic or electrical field (see Wang; Column 5, lines 10-14 and 50-57).

With respect to claim 12, the combination of Sakakima and Nickel discloses all material as stated in claim 1, and further discloses the first and second magnetic bodies are made of the same material (see Column 17, lines 62-66 and Column 18, lines 11-17) but fails to explicitly disclose wherein the first and second magnetic bodies are made of the same material, and have different shapes, such that the first and second magnetic bodies have different coercive forces due to difference of shape anisotropy.

Wang teaches the first and second magnetic bodies have different shapes and the first and second magnetic bodies have different coercive forces due to difference of shape anisotropy (see Column 5, lines 10-25; modifying the thickness modifies shape of the structure).

It would have been obvious to one of ordinary skill in the art to modify the magnetic memory device as disclosed by Sakakima by changing the shape of the ferromagnetic structures to modify the shape anisotropy as taught by Wang to modify the coercive force on the magnetic layers that gives the thicker ferromagnetic layer a magnetization which is fixed in orientation (see Wang Column 5, lines 17-23).

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in view of Nickel et al. (U.S. Patent No. 5,835,003) and Chang et al. (U.S. Patent No.

5,294,287; hereinafter referred to as Chang) as applied to claims 3-4 above, and further in view of Wang et al (U.S. Patent No. 6,713,195; hereinafter referred to as Wang).

With respect to claim 13, the combination of Sakakima, Nickel and Chang disclose all material as stated in claims 2, 3, and 4, but fails to disclose wherein different external electric fields are applied to the first and second magnetic bodies made of the magnetic semiconductor, such that the first and second magnetic bodies have different coercive forces.

Wang discloses the first and second magnetic bodies are made of the same material, and have different film thicknesses, such that the first and second magnetic bodies have different coercive forces (see Column 5, lines 3-14) and different external electric fields are applied to the first and second magnetic bodies made of the magnetic semiconductor, such that the first and second magnetic bodies have different coercive forces (see Column 5, lines 50-57).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the thickness of the device as disclosed by the combination of Sakakima and Chang to vary the switching thresholds for each of the outside composite layers while in a magnetic field as taught by Wang to allow for better control of the ferromagnetic layers in response to an externally applied operating magnetic or electrical field (see Wang; Column 5, lines 10-14 and 50-57 and Sakakima, Column 24, lines 55-66).

1. Claim 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakakima et al. (U.S. Patent No. 6,005,798; hereinafter referred to as Sakakima) in

view of Nickel et al. (U.S. Patent No. 5,835,003) as applied to claim 1 above, and further in view of Zhu et al. (U.S. Patent No. 5,734,605; hereinafter referred to as Zhu).

With respect to claim 14, the combination of Sakakima and Nickel discloses all material as stated in claim 1, but fails to disclose wherein the third magnetic body has a reduced cross-sectional area such that the magnetic domain wall is encouraged to be positioned at the first or second microjunction interface whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body.

Zhu discloses the third magnetic body has a reduced cross-sectional area such that a magnetic domain wall is encouraged to be positioned at the first or second microjunction interface(see Column 5, lines 3-9 and Column 6, line 62 – Column 7, line 5), whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body (see Column 5, lines 10-19).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the device of the combination of Sakakima and Nickel by adding an intermediate layer with a smaller cross sectional area (thinner) resulting in a lower magnetization to encourage domain wall positioning based on different magnetizations as taught by Zhu to lower the energy consumption of positioning the domain wall and that by positioning the domain walls between the first and second magnetic bodies, the magnetization vectors are high, the resistance would drop considerably allowing for better current flow (see Zhu Column 5, lines 3-19).

With respect to claim 15, the combination of Sakakima and Nickel discloses all material as stated in claim 1, but fails to disclose the third magnetic body is made of a material with a magnetization smaller than that of a material for forming the first and second magnetic body such that the magnetic domain wall is encouraged to be positioned at the first or second microjunction interface, whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body.

Zhu discloses the third magnetic body is made of a material with a magnetization smaller than that of a material for forming the first and second magnetic bodies such that the magnetic domain wall is encouraged to be positioned the first or second microjunction (see Column 5, lines 3-9 and Column 6, line 62 – Column 7, line 5), whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body (see Zhu Column 5, lines 10-19).

It would have been obvious to one of ordinary skill in the art at the time of invention to modify the device of the combination of Sakakima and Nickel by adding an intermediate layer with a smaller magnetization to encourage domain wall positioning based on different magnetizations as taught by Zhu to lower the energy consumption of positioning the domain wall and that by positioning the domain walls between the first and second magnetic bodies, the magnetization vectors are high, the resistance would drop considerably allowing for better current flow (see Zhu Column 5, lines 3-19).

With respect to claim 16, the combination of Sakakima and Nickel discloses all

material as stated in claim 1, and further discloses wherein the first to third magnetic bodies are made of the same material (see Column 18, lines 11-15 and Column 19, lines 30-39) but fails to disclose and the magnetization of the third magnetic body is rendered smaller than both that of the first magnetic body and that of the second magnetic body by applying an external electric field to the third magnetic body such that the magnetic domain wall is encouraged to be positioned at the second or microjunction interface, whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body.

Zhu discloses the first to third magnetic bodies are made of the same material and the magnetization of the third magnetic body is rendered smaller than both that of the first magnetic body and that of the second magnetic body by applying an external electric field to the third magnetic body such that a magnetic domain wall is encouraged to be positioned at the first or second microjunction interface (see Column 5, lines 3-9 and Column 6, line 62 – Column 7, line 5), whereby the energy loss due to the creation of the magnetic domain wall in the third magnetic body is less than both that in the first magnetic body and that in the second magnetic body (see Column 5, lines 10-19 and Column 19, lines 30-39).

It would have been obvious to one of ordinary skill in the art at the time of invention to render the intermediate layer of the device of the combination of Sakakima and Nickel to be smaller magnetically than the outside layers as taught by Zhu to result in a more controllable positioning of domain walls through electrical dominance of the

outside structures (see Sakakima Column 15, lines 55-60).

With respect to claim 17, the combination of Sakakima and Nickel discloses all material as stated in claim 1, but fails to explicitly disclose wherein the first and second microjunction interfaces have constrictions such that the magnetic domain wall is encouraged to be positioned at the first or second microjunction interface, (see Column 27, line 61 - Column 28, line 6 the non-magnetic films work as constrictors creating magnetic coupling between adjacent magnetic bodies) whereby the magnetic domain wall is encouraged to be trapped at one of the constrictions.

Zhu teaches wherein the first and second microjunction interfaces have constrictions such that the magnetic domain wall is encouraged to be positioned at the first or second microjunction interface, whereby the magnetic domain wall is encouraged to be trapped at one of the constrictions (see Zhu Column 5, lines 10-19).

It would have been obvious to one of ordinary skill in the art at the time of invention to producing antiparallel magnetization between the first and second magnetic bodies would result in domain walls being present therebetween resulting in a tunnel junction and lowered resistance (see Zhu Column 5, lines 10-19).

Response to Arguments

6. Applicant's arguments with respect to claims 1-21 have been considered but are moot in view of the new ground(s) of rejection.

Citation of Prior Art

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Sato et al. (U.S. Publication No. 2001/0007532 A1) discloses trilayer ferromagnetic element with changeable magnetized direction.

- Mao et al. (U.S. Patent No. 6,456,467) discloses a thin film structure used for shielding a tranducing head containing multiple ferromagnetic layering with antiparallel magnetization.

- Nakatani et al. (U.S. Patent No. 5,390,061) discloses a magnetoresistance element with multiple semiconductor and antiferromagnetic materials.

- Hempstead et al. (U.S. Patent No. 4,106,315) discloses a thin film magnetic transducer with ferromagnetic materials and antiferromagnetic material deposited on one another.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JONATHAN HAN whose telephone number is (571)270-7546. The examiner can normally be reached on Monday through Friday 9:00 AM - 6 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Loke can be reached on (571)272-1657. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JONATHAN HAN/
Examiner, Art Unit 2818

/DAVID VU/
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